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1 Babytherm 8004

The Babytherm 8004 is an open incubator for keeping premature babies and infants with a body weight of up to 8 kg warm.

The Babytherm 8004 provides warmth by a radiant heater in “manual mode “ with automatic “skin temperature control”.

The Babytherm 8004 is used in the delivery room, the neonatal ward, the children’s ward and the children’s intensive care unit. The Babytherm 8004 is operated by a doctor, or by nurses or orderlies under the supervision of a doctor.

Danger of burns! Infants who are in shock have a markedly lower than normal skin temperature, and would be overexposed if skin temperature regulation were used. **Do not use skin temperature regulation for infants who are in shock!**

Danger of hypothermia! Infants who have a fever have a markedly higher than normal skin temperature, and would experience hypothermia if skin temperature regulation were used. **Do not use skin temperature regulation for infants who have a fever!**

Incorrect measurements! If the skin temperature sensor is used rectally in the skin temperature regulation operating mode, the core temperature is measured and regulated. **Do not use the skin temperature sensor rectally!**

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The Babytherm 8004 includes a radiant heater, a control unit, a resting surface and a trolley.

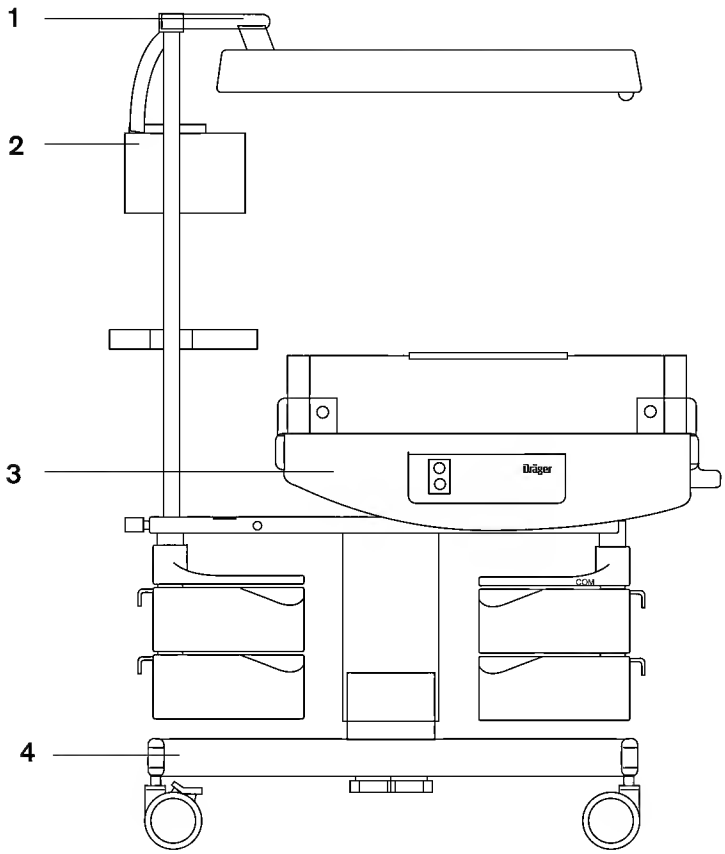

Fig. 1: Front view of the Babytherm 8004

Legend

Table 1:

1	Radiant heater
2	Control unit
3	Resting surface
4	Trolley without electric height adjustment Trolley with electric height adjustment (optional)

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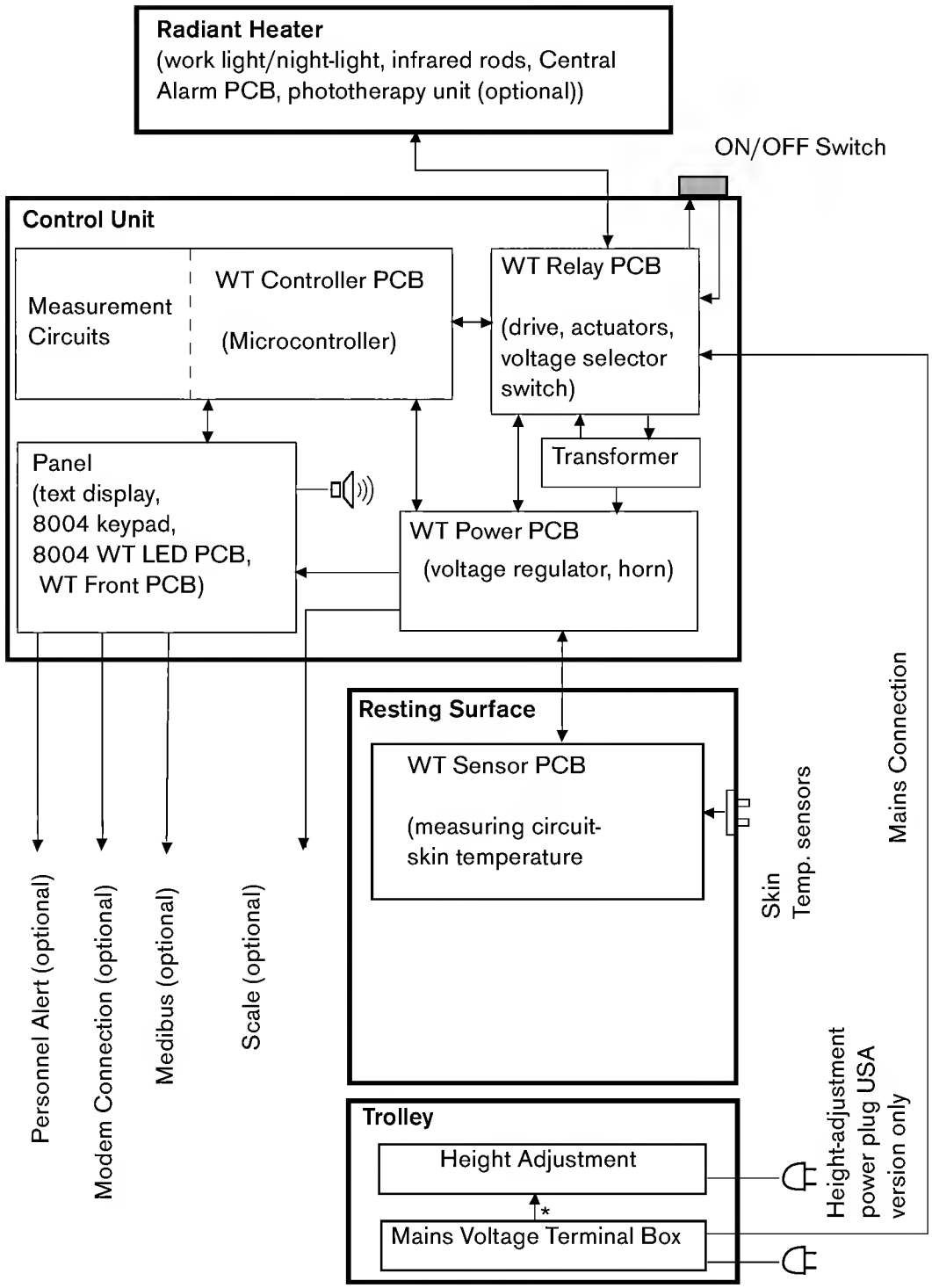

Fig. 2: Block diagram of the Babytherm 8004

* The connection between the mains voltage terminal box and the height-adjustment is not available in the USA version.

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1.1 Radiant Heater

The radiant heater emits a pre-set amount of heat. A multi-conductor cable connects the radiant heater to the control unit.

The radiant heater contains the following subassemblies:

- Two infrared rods (600 W overall power)
- Energy-saving lamp (7 W)
- Energy-saving lamp (23 W)
- Central Alarm PCB
- Six halogen lamps (50 W) for phototherapy unit (optional)
- Switched-Mode Power Supply PCB for phototherapy unit (optional).

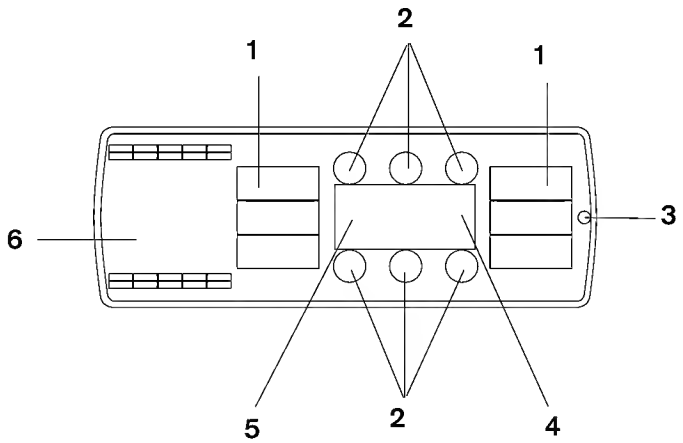

Fig. 3: bottom view of radiant heater

Legend

Table 2:

1	Infrared rod
2	Halogen lamps for phototherapy unit (optional)
3	Central Alarm PCB
4	Energy-saving lamp no. 1
5	Energy-saving lamp no. 2
6	Switched-Mode Power Supply PCB for phototherapy unit (optional)

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When the button for the work light is pressed, both energy-saving lamps (energy-saving lamp no. 1 and energy-saving lamp no. 2) are switched on.

When the night-light button is pressed, only energy-saving lamp no. 1 is switched on.

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1.2 Control Unit

The control unit controls and regulates the functions of the Babytherm 8004.

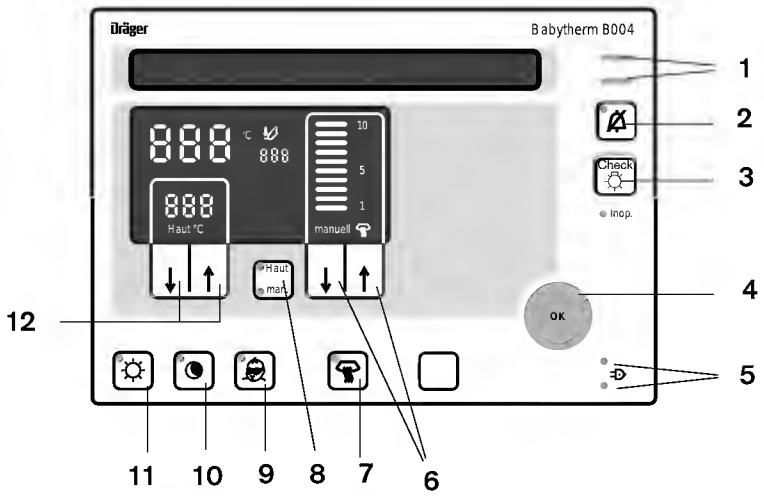

Fig. 4: Front view of the control unit of Babytherm 8004

Legend

Table 3:

1	Alarm LED (red alarm LED = warning, yellow alarm LED = caution)
2	Reset key (silence key) (15 minute alarm/10 minute alarm)
3	Check key (test LEDs and audible alarm)
4	OK key
5	LEDs (green LED = operating mode, red LED = powerfail)
6	Heat level adjustment for radiant heater
7	Radiant heater ON/OFF switch
8	Skin/manual key (selector switch: manual power adjustment/skin temperature regulation)
9	Phototherapy unit ON/OFF switch (optional)
10	Night-light ON/OFF switch (energy-saving lamp no. 1)
11	Work light ON/OFF switch (energy-saving lamp no. 1 and energy-saving lamp no. 2)
12	Skin temperature regulation target value adjustment

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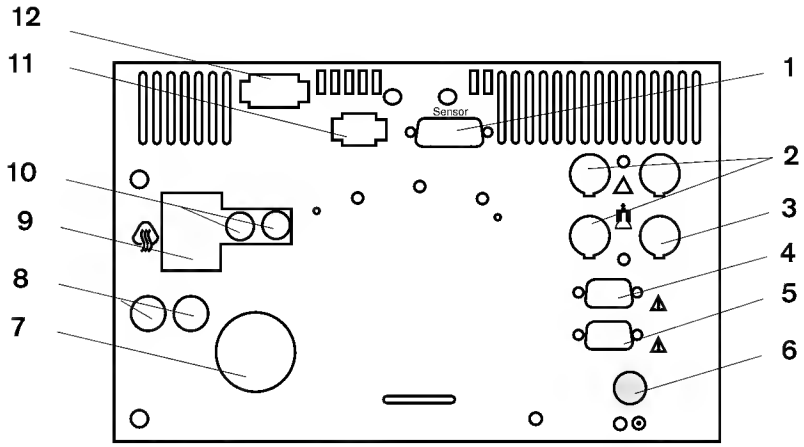

Fig. 5: Rear view of the control unit 8004

Legend

Table 4:

1	Connection for WT Sensor PCB
2	Connections for personnel alert; max. 3 devices of workplace (connections for central alarm)
3	Connection for public address system, personnel alert (connection for central alarm)
4	RS 232 interface (modem), optional
5	RS 232 interface (BabyLink), optional
6	Control unit ON/OFF switch
7	Voltage Selector Switch
8	Fuses
9	Connection for radiant heater
10	Fuses
11	Connection for mattress heater
12	Connection for mains power supply

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The control unit consists of the following subassemblies:

- ON/OFF switch
- Toroidal-core power transformer
- WT Power PCB
- WT Relay PCB
- WT Controller PCB
- Panel (8004 WT LED PCB, 8004 keypad, text display, WT Front PCB, loudspeaker).

1.2.1 ON/OFF Switch

The single pole ON/OFF switch switches the mains voltage on or off.

1.2.2 Toroidal-Core Power Transformer

The toroidal-core power transformer supplies the electronics and the mattress heater with the following alternating voltages:

- approximately 24 VAC
- approximately 9 VAC.

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1.2.3 WT Power PCB

The WT Power PCB consists of the following functional modules:

- Bridge rectifier
- Voltage regulator (+5 VD)
- Voltage regulator (+5 VLED)
- GoldCap
- Charging circuit (GoldCap)
- Mains voltage power failure recognition
- Horn (mains voltage failure)
- Alarm LED drive (mains voltage failure)
- Serial data transmission
- Multiplexer
- Addressing and drive for actuators and safety relays.

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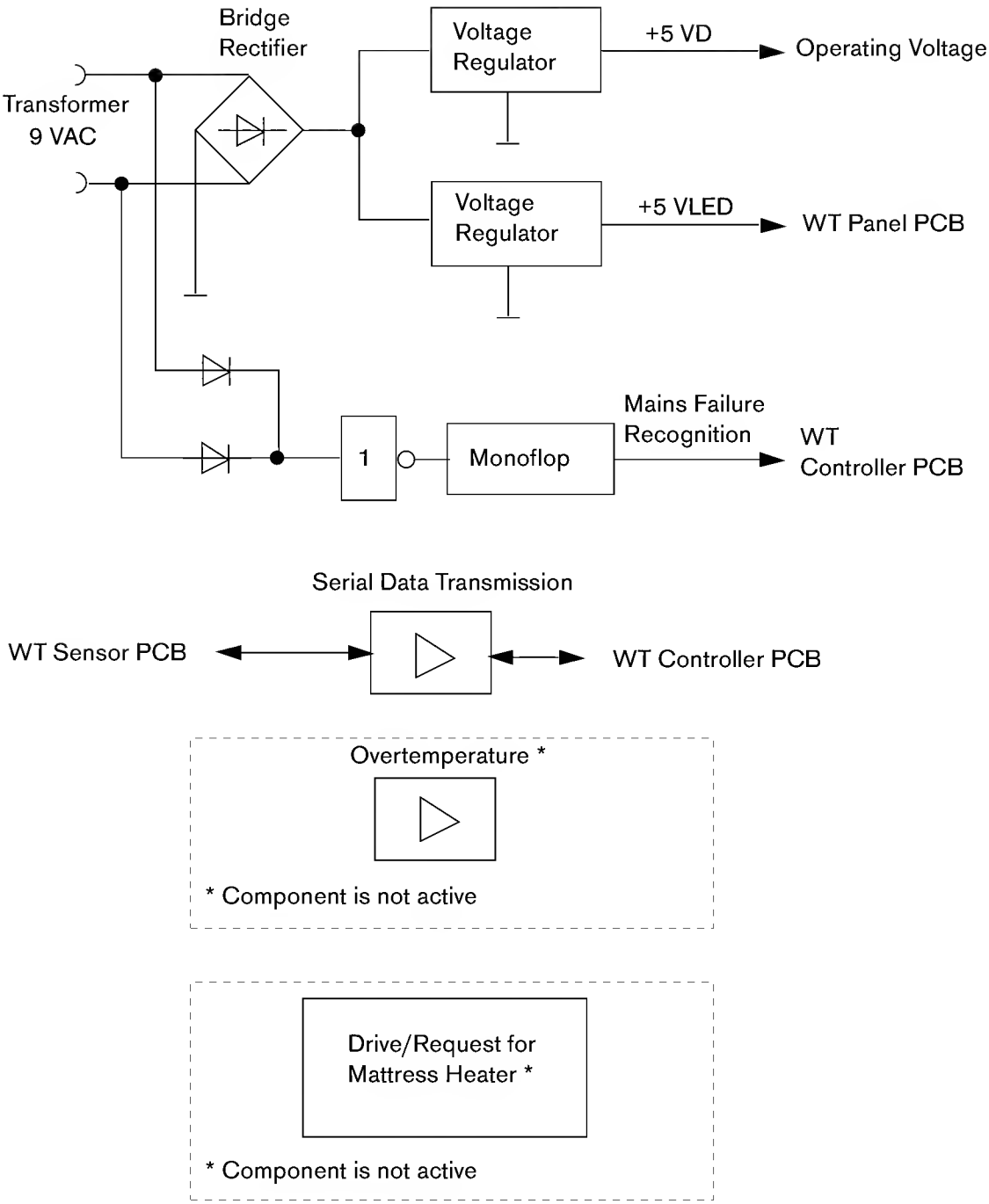

Fig. 6: Block diagram 1 of WT Power PCB

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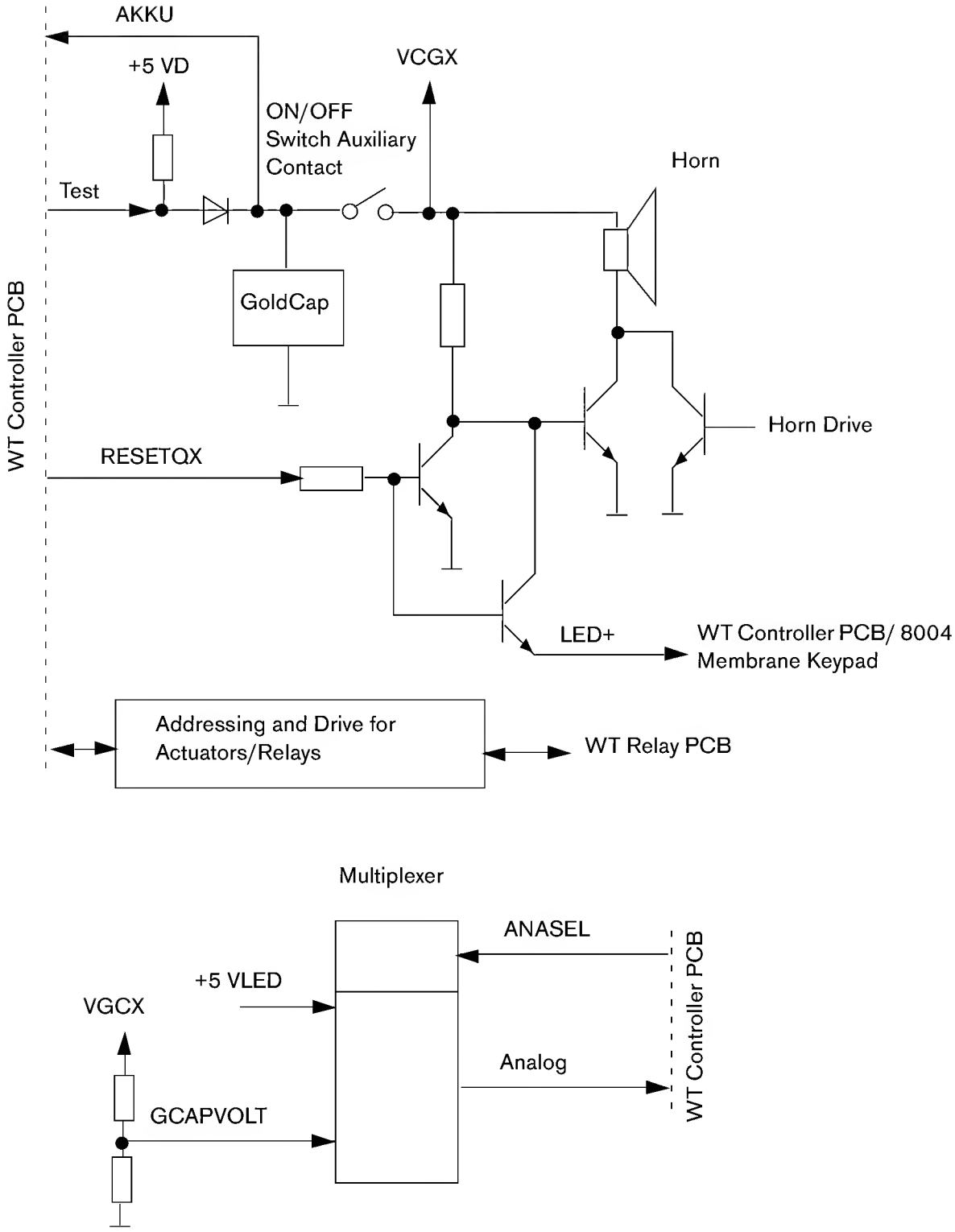

Fig. 7: Block diagram 2 of WT PCB Power Supply

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Bridge Rectifier

The toroidal-core power transformer applies approximately 10 VAC to the bridge rectifier input from which an uncontrolled direct voltage of approximately 9 VDC is generated.

Voltage Regulator (+5 VD)

The controlled operating voltage +5 VD is generated from the uncontrolled 9 V direct voltage by a voltage regulator.

Voltage Regulator (+5 VLED)

The controlled operating voltage +5 VLED is generated from the uncontrolled 9 V direct voltage by a voltage regulator.

GoldCap

The GoldCap supplies the horn and the mains failure LED with operating voltage in the event of mains voltage failure. The GoldCap voltage accumulator also buffers microcontroller RAM.

Charging Circuit (GoldCap)

The internal + 5VD operating voltage charges via a resistor-diode circuit the GoldCap. The charging circuit is switched off once per second for testing purposes.

Mains Voltage Power Failure Recognition

A monoflop recognises a failure of the mains voltage supply.

Horn (Mains Voltage Failure)

A GoldCap provides for horn operating voltage in the event of a mains voltage failure.

Alarm LED Drive (Mains Voltage Failure)

A GoldCap provides for alarm LED operating voltage in the event of a mains voltage failure.

Serial Data Transmission

A driver module amplifies serial measurement data of the skin temperature, test signals and control signals.

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Multiplexer

The multiplexer switches the voltages (GCAPVOLT, +5 VLED) to the WT Controller PCB for testing.

Addressing and Drive for Actuators and Relays

An addressing module, a shift register and an amplification module call up the actuators and the safety relay for the radiant heater.

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1.2.4 WT Relay PCB

The energy-saving lamps, the infrared rods, the Central Alarm PCB and the radiant heater phototherapy unit (optional) are driven by relays located on the WT Relay PCB. A triac controls the infrared rods.

The WT Relay PCB contain the following subassemblies:

- Voltage selector switch
- Infrared rods drive/feedback
- Infrared rod safety relay
- Relays (energy-saving lamps, phototherapy unit (optional))
- Drive for Central Alarm PCB.

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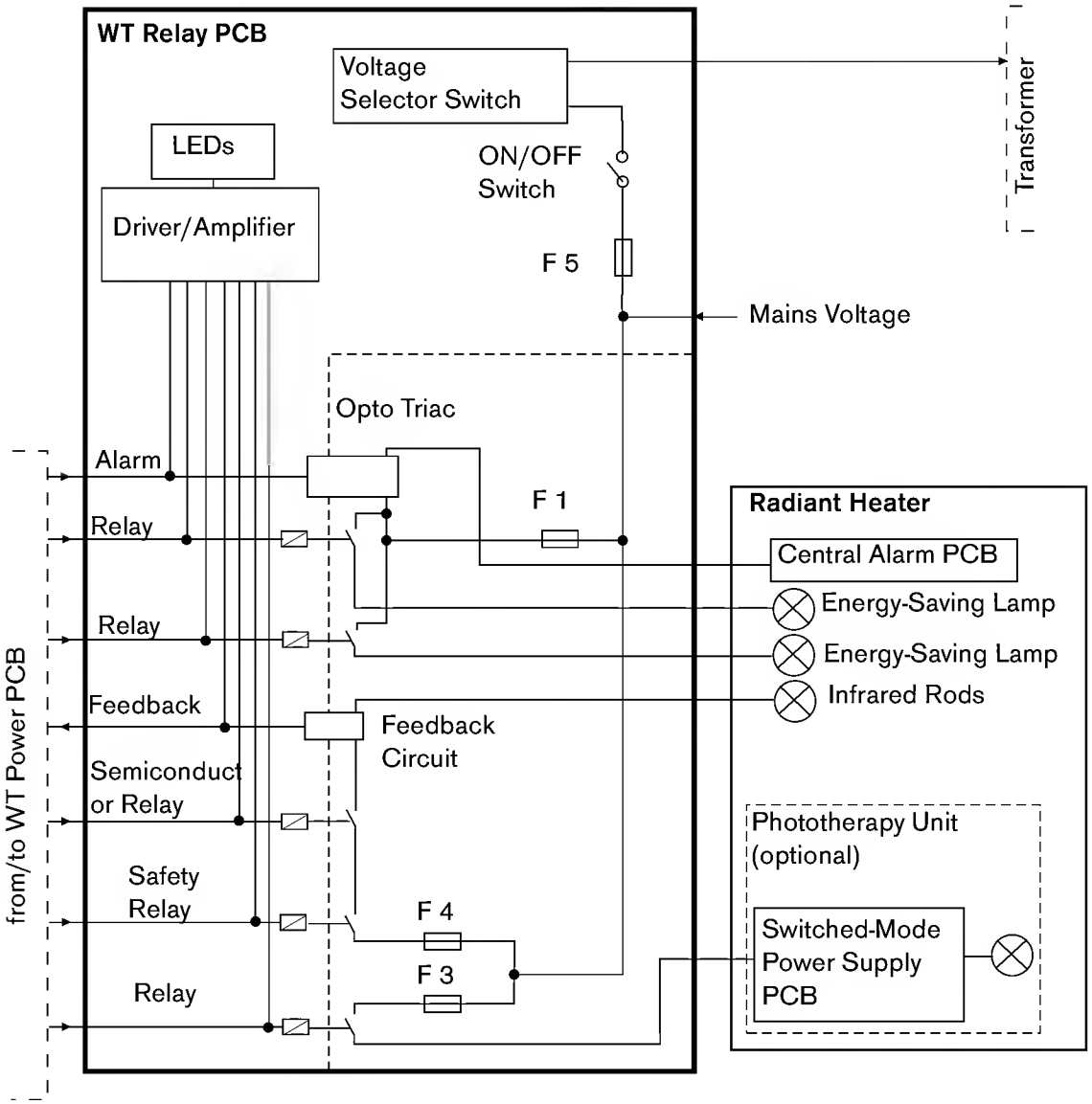

Fig. 8: Block Diagram of WT Relay PCB

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Voltage Selector Switch

The voltage selector switch allows for adapting the primary circuit of the toroidal-core power transformer to the local mains voltage.

Radiant Heater Drive/Feedback

An optocoupler drives the triac, which supplies the infrared rods with mains voltage. The voltage of the infrared rods generates an acknowledgement signal with an optocoupler.

Infrared Rod Safety Relay

The safety relay interrupts mains voltage to the infrared rods in the event of an error (e.g. “Inop”).

Relays (Energy-Saving Lamps, Phototherapy Unit (optional))

The relays supply the energy-saving lamps and the phototherapy unit (optional) with mains voltage.

Drive for Central Alarm PCB

An opto triac at the WT Relay PCB drives the central alarm lamp. The opto triac supplies the Central Alarm PCB with mains voltage.

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1.2.5 WT Controller PCB

The WT Controller PCB contains the following subassemblies:

- Microcontroller
- Quartz element
- EPROM
- EEPROM
- RAM
- Watchdogs
- Driver elements
- Multiplexer and A-D converter.

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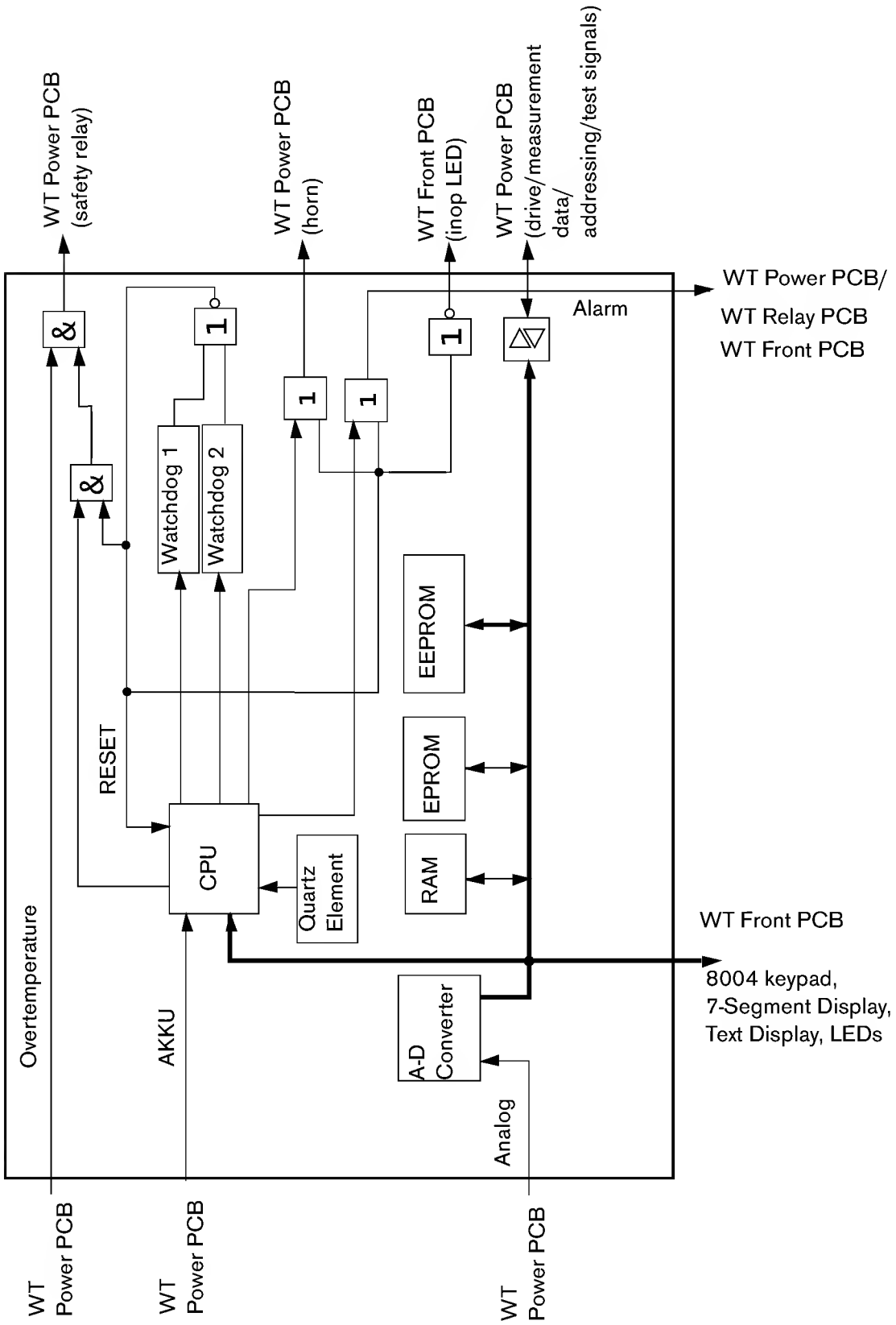

Fig. 9: Block Diagram of WT Controller PCB

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Microcontroller

The microcontroller controls and monitors the Babytherm program. The microcontroller contains 2 KB RAM. Target values are stored and buffered in this RAM. An accumulator RAM buffer voltage is generated by the GoldCap.

Quartz Element

The quartz element generates a pulse frequency of approximately 32 MHz. The microcontroller generates a frequency of 16 MHz with this pulse frequency.

EPROM

The EPROM contains the Babytherm software program.

EEPROM

The EEPROM stores device configuration data.

RAM

The RAM is the main memory.

Watchdogs

The watchdogs monitor the software program sequence of the microcontroller. The watchdogs are counting elements, which are timed with a separate quartz element.

If the microcontroller does not reset the counting elements, an EMERGENCY STOP signal is generated.

Driver Elements

The driver elements amplify the signals and adjust their levels for the actuator driver.

Multiplexer and A-D Converter

The A-D Converter converts the +5 VLED voltage and the GoldCap voltage into a digital data word. This data word is sent to the microcontroller for the purpose of evaluation.

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1.2.6 WT Sensor PCB

The WT Sensor PCB includes the following subassemblies:

- Receiver and sender for serial data transmission
- Test signal select logic
- Measurements amplifiers of skin temperature
- Test circuit (36.0 °C - skin temperature)
- A-D conversion with multiplexer.

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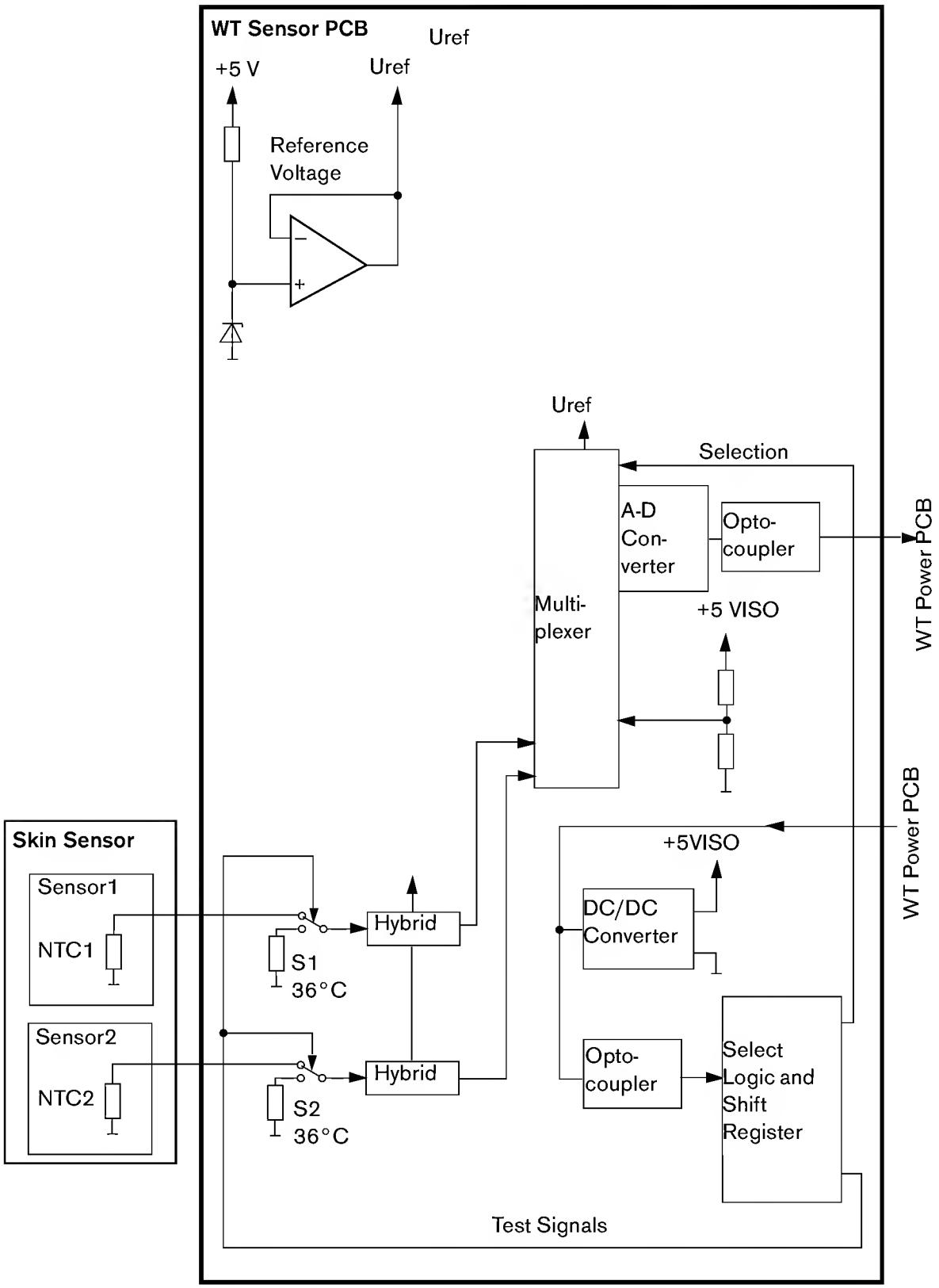

Fig. 10: Block diagram of WT Sensor PCB

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Receiver and Sender for Serial Data Transmission

Optocouplers transmit the serial measurement data of skin temperature and the WT Sensor PCB operating voltage to the WT Power PCB. One optocoupler receives the test signals in serial mode for the measurement circuits.

Test Signal Select Logic

An addressing module and a shift register convert the serial test signals into parallel data.

The test signals activate the skin temperature 36 °C test circuit.

Measurement Amplifier of the Skin Temperature

Two skin temperature hybrids measure the skin temperature.

Test Circuit (36.0 °C - Skin Temperature)

The software monitors the skin temperature hybrid.

Reference resistors, which are linked to the test circuits, are connected to the inputs of the skin temperature hybrids. The output voltage values of the skin temperature hybrids correspond to a temperature of 36.0 °C.

A-D Conversion with Multiplexer

The multiplexer sends an analog measurement signal of skin temperature to the integrated A-D converter. The serial output signal from the A-D converter is connected to an optocoupler.

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1.3 Panel

The panel consists of the following subassemblies:

- 8004 WT LED PCB
- 8004 keypad
- Text display
- WT Front PCB
- Loudspeaker.

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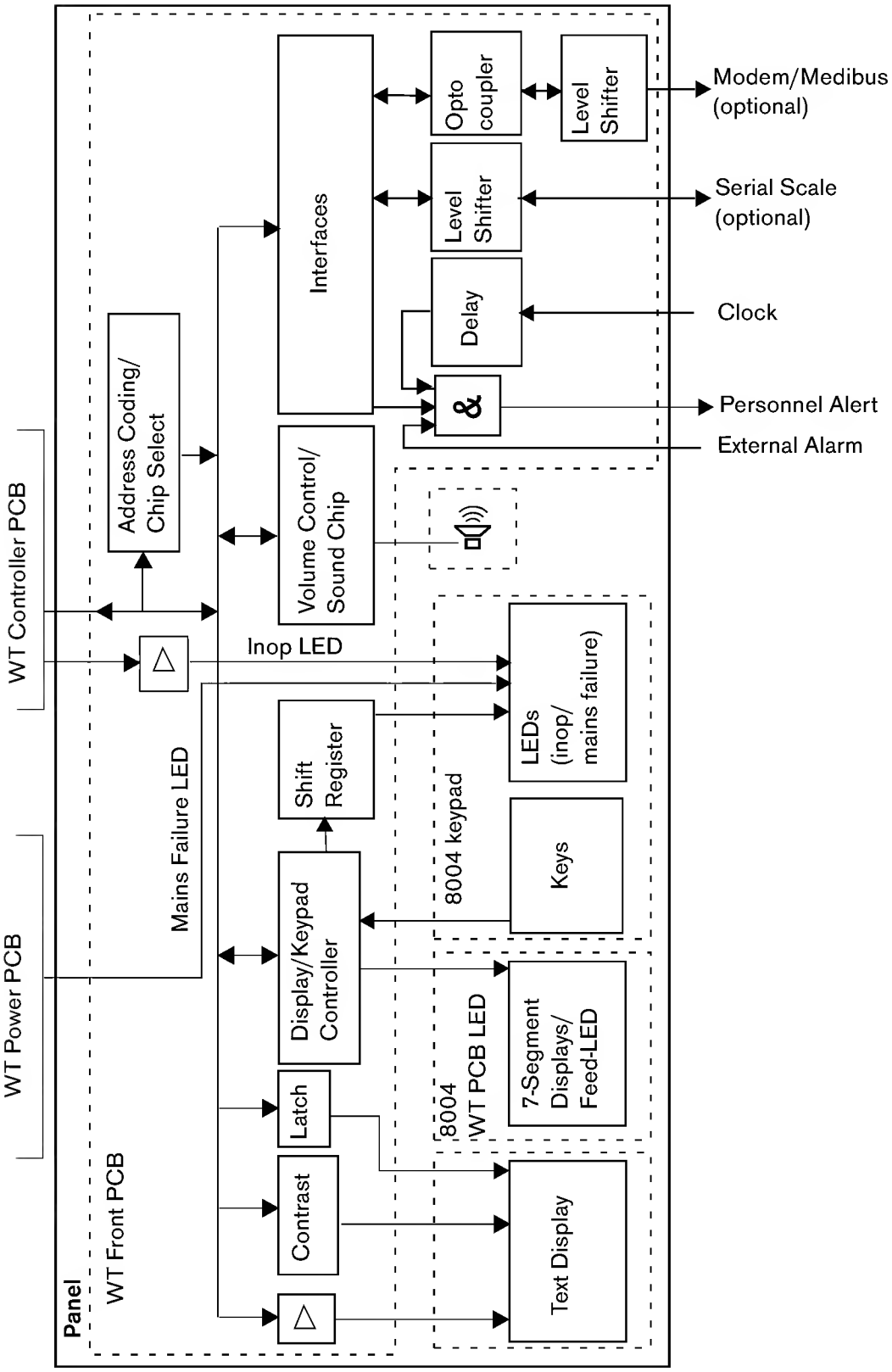

Fig. 11: Block diagram of the Panel

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1.3.1 8004 WT LED PCB

The 8004 WT LED PCB contains 7-segment displays to represent the skin temperature and a light emitting diode for display the feed symbol.

1.3.2 8004 Keypad

The 8004 keypad includes a key array, keys and LEDs.

1.3.3 Text Display (LC display)

The text display shows clear text messages (comments, warnings, alarms and commands).

1.3.4 Loudspeaker

Acoustic alarms are generated at the loudspeaker for alarms and comments. A volume control and a sound chip control the loudspeaker.

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1.3.5 WT Front PCB

A port component reads in the key array. LED drive is accomplished with decoders, shift registers and multiplex signals.

The WT Front PCB contains the following subassemblies:

- Address coding and chip select
- Sound chip with volume regulator
- Text display contrast adjustment
- Text display latch drive
- Voltage supply for text display backlighting
- Personnel alert
- Interface modules
- Level shifters
- Optocouplers
- Display module
- LED matrix drive.

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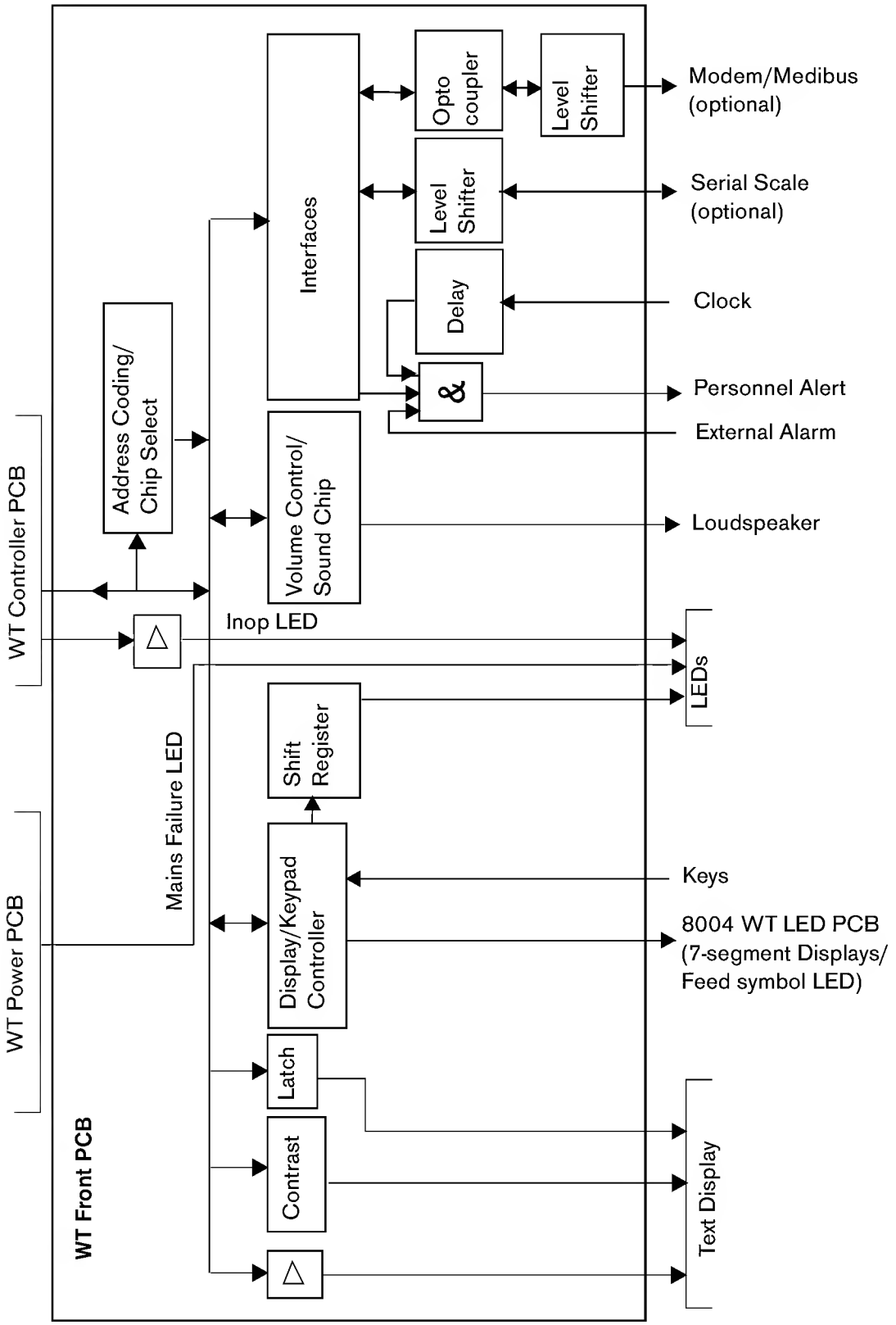

Fig. 12: Block Diagram of the WT Front PCB

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Address Coding and Chip Select

Addressing and selection modules select the various hardware components.

Sound Chip with Volume Regulator

The microcontroller links the output signal of the sound chip to the output signal of the volume regulator. The combined signal is amplified and fed to the loudspeaker.

The microcontroller can influence the volume of the volume regulator via software.

Text Display Contrast Adjustment

An amplifier module enables contrast adjustment at the text display.

Text Display Latch Drive

Latch modules drive the text display signal.

Voltage Supply for Text Display Illumination

A switching controller supplies the text display backlighting foil with a voltage of approximately 1.0 V to 5.0 V.

Personnel Alert

In the event of an alarm a relay is activated. The relay functions as a selector switch. An external alarm system can be connected to the selector switch (e.g. personnel alert).

An alarm delay prevents the personnel alert from being immediately activated after the Check key has been actuated.

Interface Modules

The interface modules link the data bus to the peripheral units (medibus, modem, scale).

Level Shifters

The level shifters adapt the WT Front PCB interface to the peripheral devices interfaces.

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Optocouplers

Optocouplers isolate the modem, the medibus and the central alarm from the WT Front PCB.

Display Module

The display module provides the 7-segment display with operating voltage. The display module selects the individual keys. The display module stores the actuated key in an storage area, and sends this as information to the data bus.

LED Matrix Drive

A shift register and select logic drive the LED matrix.

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2 Babytherm 8010

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The Babytherm 8010 is used in the delivery room, the neonatal ward, the children’s ward and the children’s intensive care unit. The Babytherm 8010 is operated by a doctor, or by nurses or orderlies under the supervision of a doctor.

Danger of burns! Infants who are in shock have a markedly lower than normal skin temperature, and would be overexposed if skin temperature regulation were used. **Do not use skin temperature regulation for infants who are in shock!**

Danger of hypothermia! Infants who have a fever have a markedly higher than normal skin temperature, and would experience hypothermia if skin temperature regulation were used. **Do not use skin temperature regulation for infants who have a fever!**

Incorrect measurements! If the skin temperature sensor is used rectally in the skin temperature regulation operating mode, the core temperature is measured and regulated. **Do not use the skin temperature sensor rectally!**

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The Babytherm 8010 includes a radiant heater, a control unit, a resting surface and a trolley.

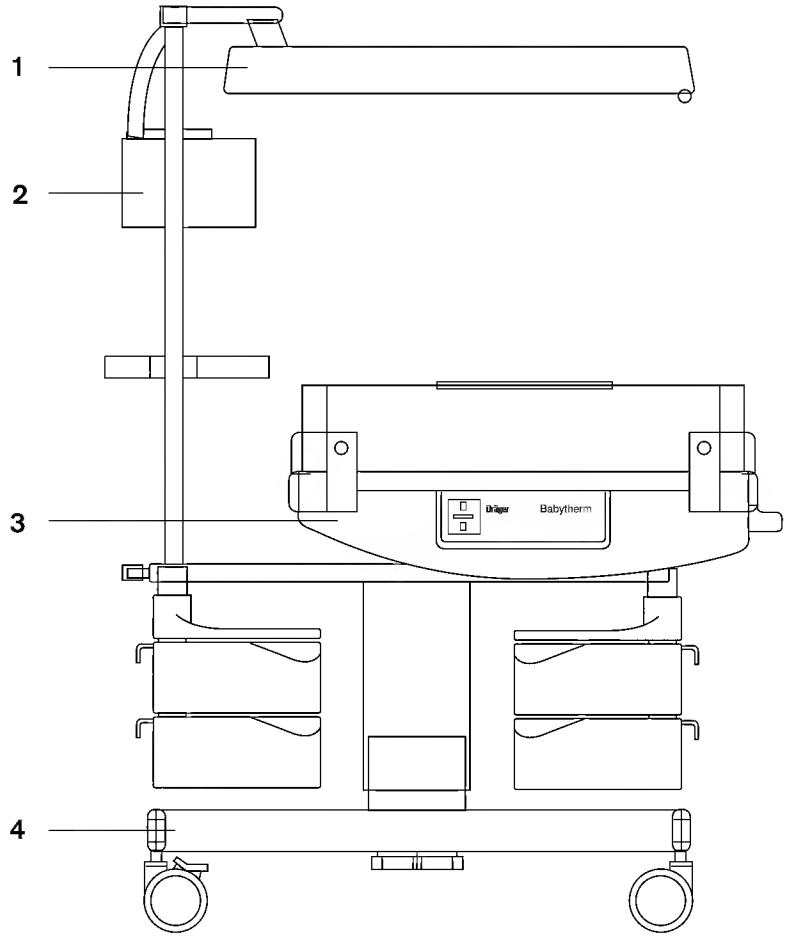

Fig. 13: Front view of the Babytherm 8010

Legend

Table 5:

1	Radiant heater
2	Control unit
3	Resting surface
4	Trolley without electric height adjustment Trolley with electric height adjustment (optional)

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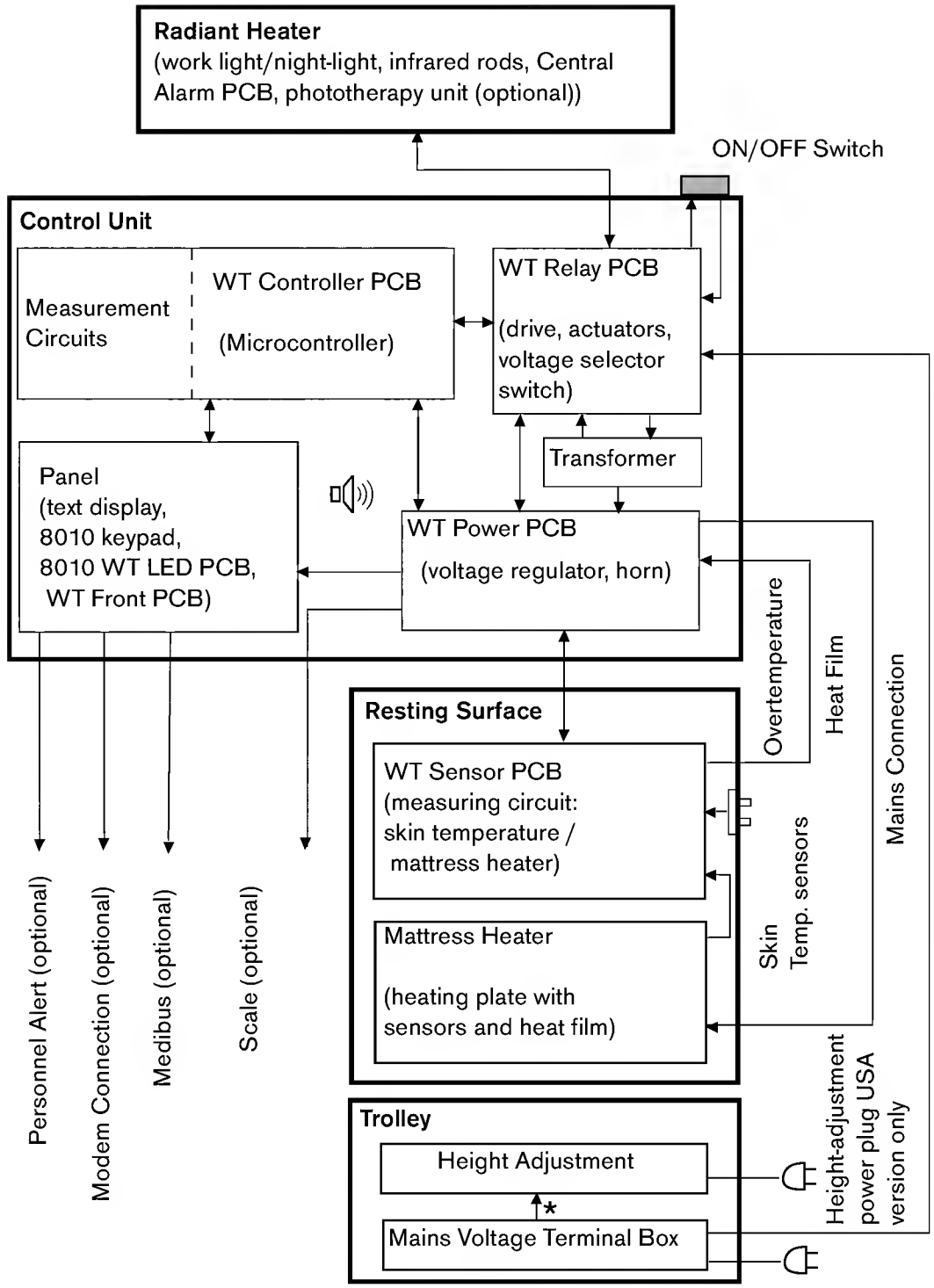

Fig. 14: Block diagram of the Babytherm 8010

* The connection between the mains voltage terminal box and the height adjustment is not available in the USA version.

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2.1 Radiant Heater

The radiant heater emits a pre-set amount of heat. A multi-conductor cable connects the radiant heater to the control unit.

The radiant heater contains the following subassemblies:

- Two infrared rods (600 W overall power)
- Energy-saving lamp (7 W)
- Energy-saving lamp (23 W)
- Central Alarm PCB
- Six halogen lamps (50 W) for phototherapy unit (optional)
- Switched-Mode Power Supply PCB for phototherapy unit (optional).

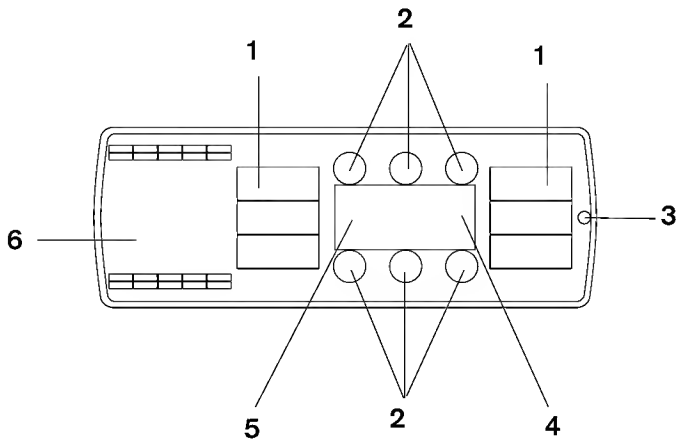

Fig. 15: bottom view of radiant heater

Legend

Table 6:

1	Infrared rod
2	Halogen lamps for phototherapy unit (optional)
3	Central Alarm PCB
4	Energy-saving lamp no. 1
5	Energy-saving lamp no. 2
6	Switched-Mode Power Supply PCB for phototherapy unit (optional)

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When the button for the work light is pressed, both energy-saving lamps (energy-saving lamp no. 1 and energy-saving lamp no. 2) are switched on.

When the night-light button is pressed, only energy-saving lamp no. 1 is switched on.

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2.2 Control Unit

The control unit controls and regulates the functions of the Babytherm 8010.

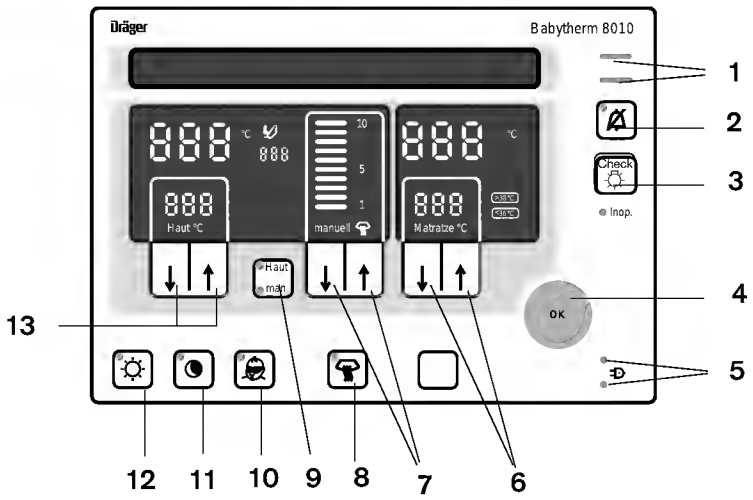

Fig. 16: Front view of the control unit of Babytherm 8010

Legend

Table 7:

1	Alarm LED (red alarm LED = warning, yellow alarm LED = caution)
2	Reset key (silence key) (15 minute alarm/10 minute alarm)
3	Check key (test LEDs and audible alarm)
4	OK key
5	LEDs (green LED = operating mode, red LED = powerfail)
6	Target value adjustment for mattress heater
7	Heat level adjustment for radiant heater
8	Radiant heater ON/OFF switch
9	Skin/manual key (selector switch: manual power adjustment/skin temperature regulation)
10	Phototherapy unit ON/OFF switch (optional)
11	Night-light ON/OFF switch (energy-saving lamp no. 1)
12	Work light ON/OFF switch (energy-saving lamp no. 1 and energy-saving lamp no. 2)
13	Skin temperature regulation target value adjustment

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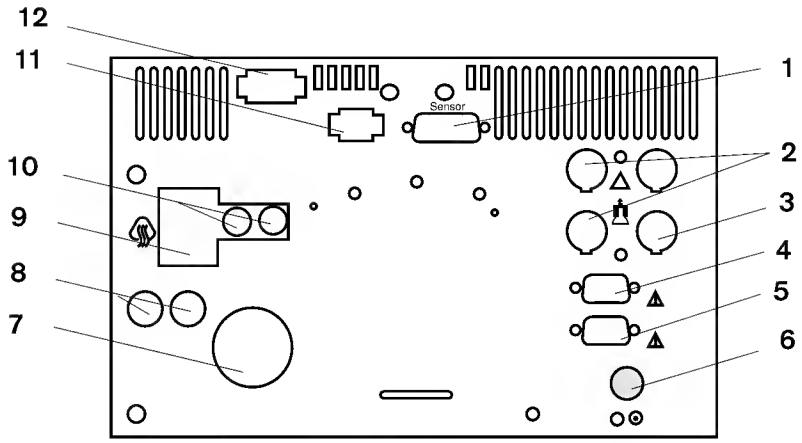

Fig. 17: Rear view of the control unit

Legend

Table 8:

1	Connection for WT Sensor PCB
2	Connections for personnel alert; max. 3 devices of workplace (connections for central alarm)
3	Connection for public address system, personnel alert (connection for central alarm)
4	RS 232 interface (modem), optional
5	RS 232 interface (BabyLink), optional
6	Control unit ON/OFF switch
7	Voltage Selector Switch
8	Fuses
9	Connection for radiant heater
10	Fuses
11	Connection for mattress heater
12	Connection for mains power supply

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The control unit consists of the following subassemblies:

- ON/OFF switch
- Toroidal-core power transformer
- WT Power PCB
- WT Relay PCB
- WT Controller PCB
- Panel (8010 WT LED PCB, 8010 keypad, text display, WT Front PCB, loudspeaker).

2.2.1 ON/OFF Switch

The single pole ON/OFF switch switches the mains voltage on or off.

2.2.2 Toroidal-Core Power Transformer

The toroidal-core power transformer supplies the electronics and the mattress heater with the following alternating voltages:

- approximately 24 VAC
- approximately 9 VAC.

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2.2.3 WT Power PCB

The WT Power PCB consists of the following functional modules:

- Bridge rectifier
- Voltage regulator (+5 VD)
- Voltage regulator (+5 VLED)
- GoldCap
- Charging circuit (GoldCap)
- Mains voltage power failure recognition
- Horn (mains voltage failure)
- Alarm LED drive (mains voltage failure)
- Serial data transmission
- Multiplexer
- Addressing and drive for actuators and safety relays
- Drive/request for mattress heater.

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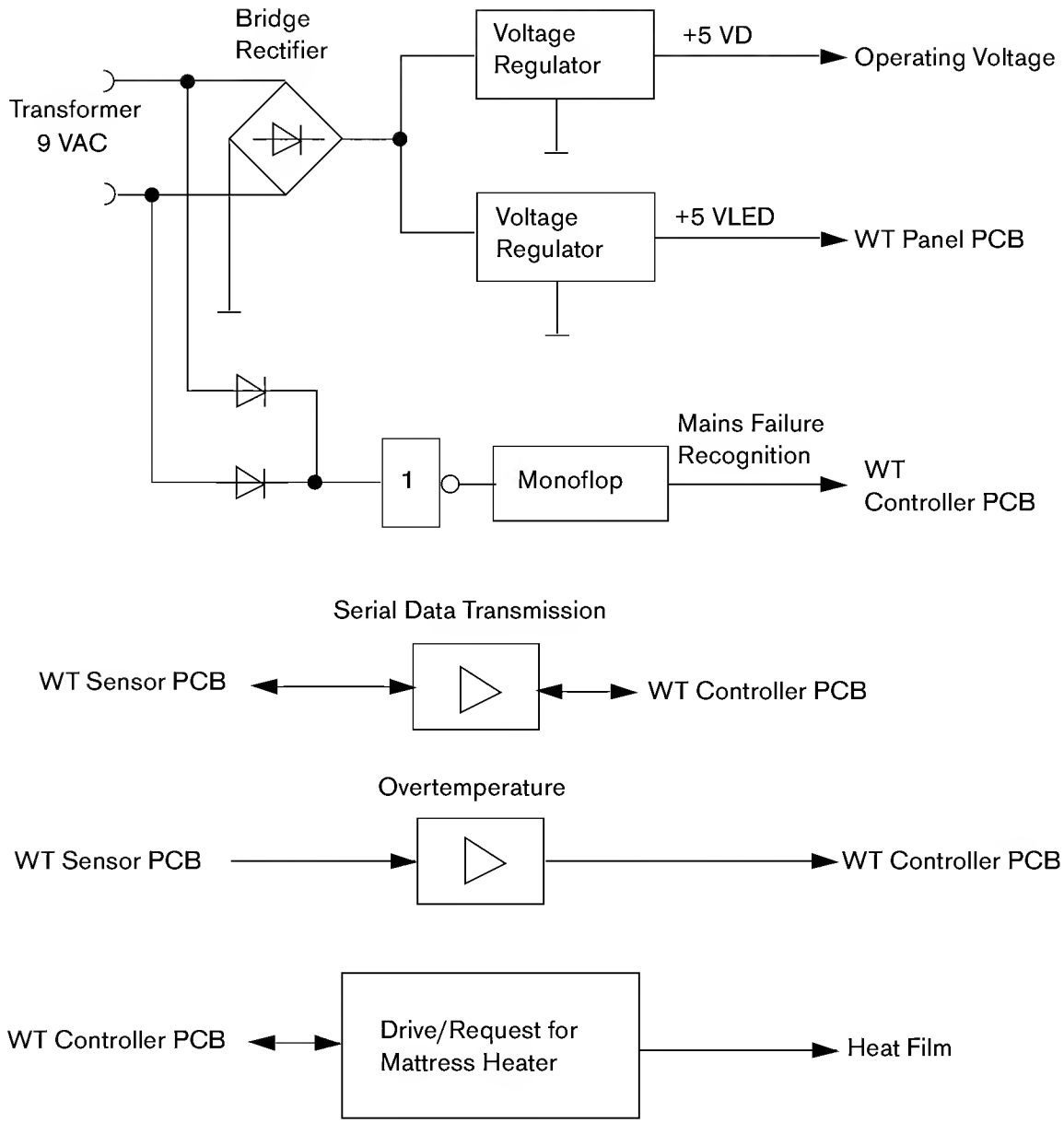

Fig. 18: Block diagram 1 of WT Power PCB

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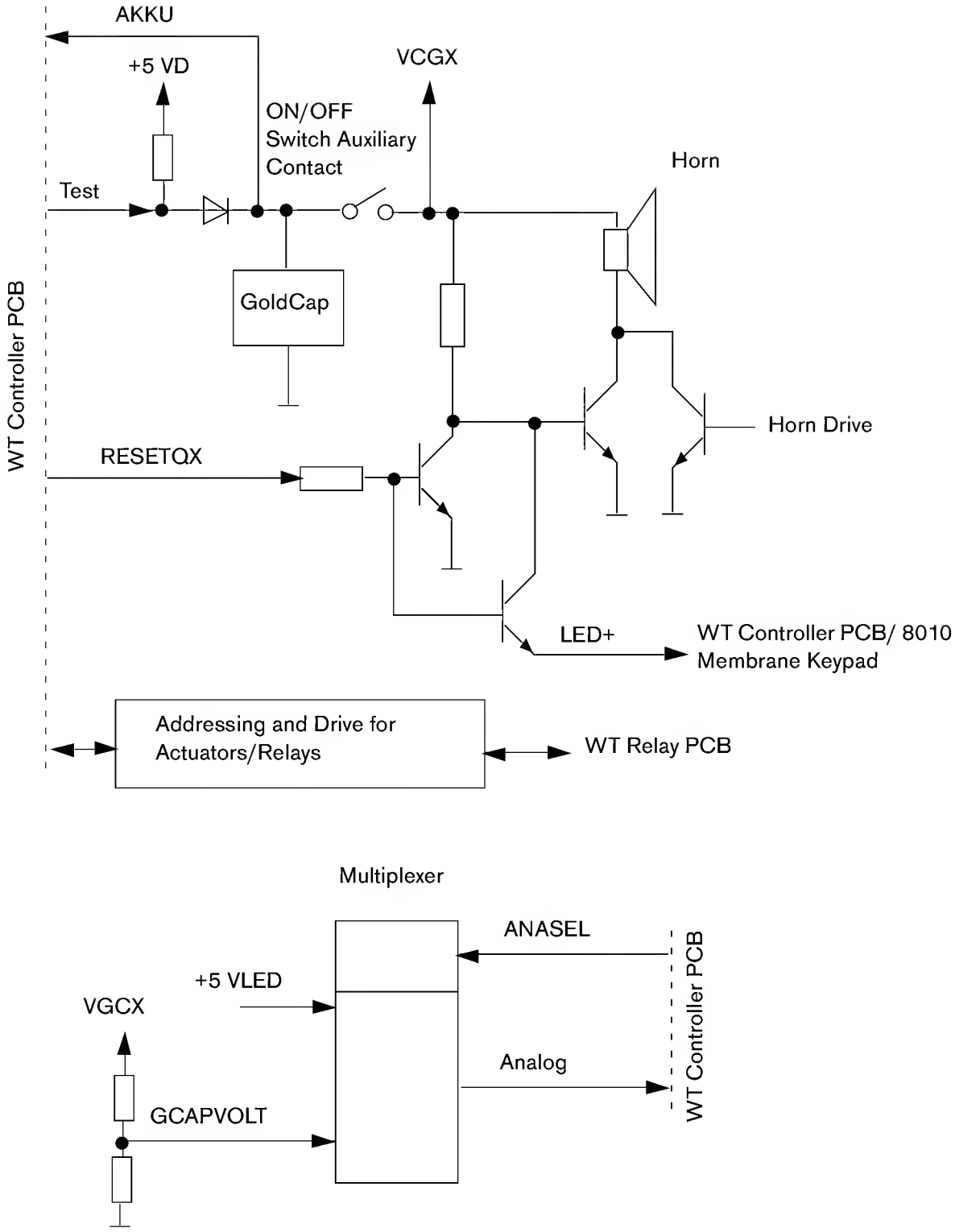

Fig. 19: Block diagram 2 of WT PCB Power Supply

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Bridge Rectifier

The toroidal-core power transformer applies approximately 10 VAC to the bridge rectifier input from which an uncontrolled direct voltage of approximately 9 VDC is generated.

Voltage Regulator (+5 VD)

The controlled operating voltage +5 VD is generated from the uncontrolled 9 V direct voltage by a voltage regulator.

Voltage Regulator (+5 VLED)

The controlled operating voltage +5 VLED is generated from the uncontrolled 9 V direct voltage by a voltage regulator.

GoldCap

The GoldCap supplies the horn and the mains failure LED with operating voltage in the event of mains voltage failure. The GoldCap voltage accumulator also buffers microcontroller RAM.

Charging Circuit (GoldCap)

The internal + 5VD operating voltage charges via a resistor-diode circuit the GoldCap. The charging circuit is switched off once per second for testing purposes.

Mains Voltage Power Failure Recognition

A monoflop recognises a failure of the mains voltage supply.

Horn (Mains Voltage Failure)

A GoldCap provides for horn operating voltage in the event of a mains voltage failure.

Alarm LED Drive (Mains Voltage Failure)

A GoldCap provides for alarm LED operating voltage in the event of a mains voltage failure.

Serial Data Transmission

A driver module amplifies serial measurement data (skin temperature, mattress temperature and overtemperature), test signals and control signals.

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Multiplexer

The multiplexer switches the voltages (GCAPVOLT, +5 VLED) to the WT Controller PCB for testing.

Addressing and Drive for Actuators and Relays

An addressing module, a shift register and an amplification module call up the actuators and the safety relay for the radiant heater.

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Drive/Request for Mattress Heater

The operating voltage for the mattress heater is approximately 24 VAC. The heating circuit is isolated from the direct voltage and is protected with a fuse. A safety relay interrupts the heating circuit in case of error. A triac is used for switching of the heater during operation. A series connected zero-potential, phase group switch only switches the heater on when positive AC voltage passage occurs, and off when negative AC voltage passage occurs.

The voltage drop at the mattress heater generates impulses with a parallel connected optocoupler, which drive a monoflop. The monoflop output indicates that the mattress heater is in the operational mode.

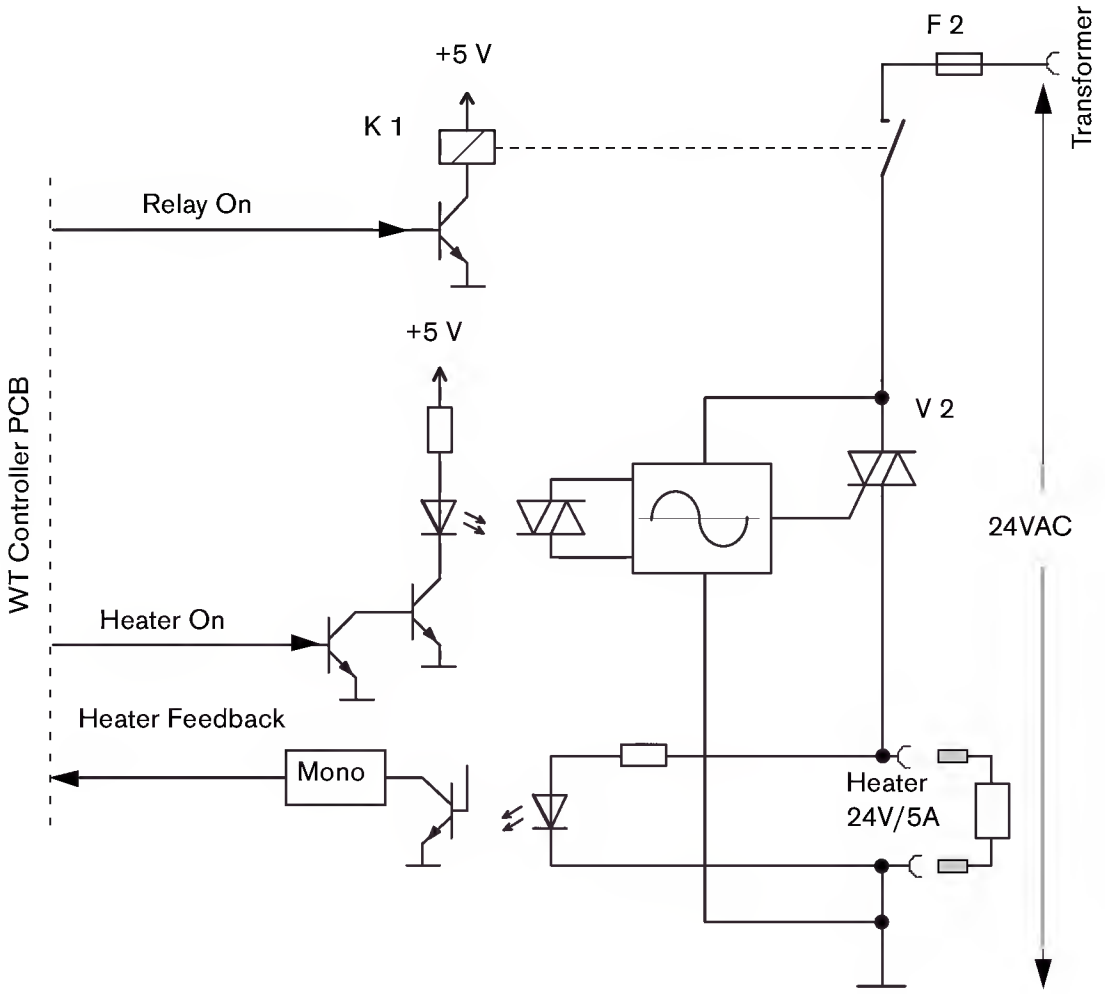

Fig. 20: Block diagram 3 of WT Power PCB

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2.2.4 WT Relay PCB

The energy-saving lamps, the infrared rods, the Central Alarm PCB and the radiant heater phototherapy unit (optional) are driven by relays located on the WT Relay PCB. A triac controls the infrared rods.

The WT Relay PCB contain the following subassemblies:

- Voltage selector switch
- Infrared rods drive/feedback
- Infrared rod safety relay
- Relays (energy-saving lamps, phototherapy unit (optional))
- Drive for Central Alarm PCB.

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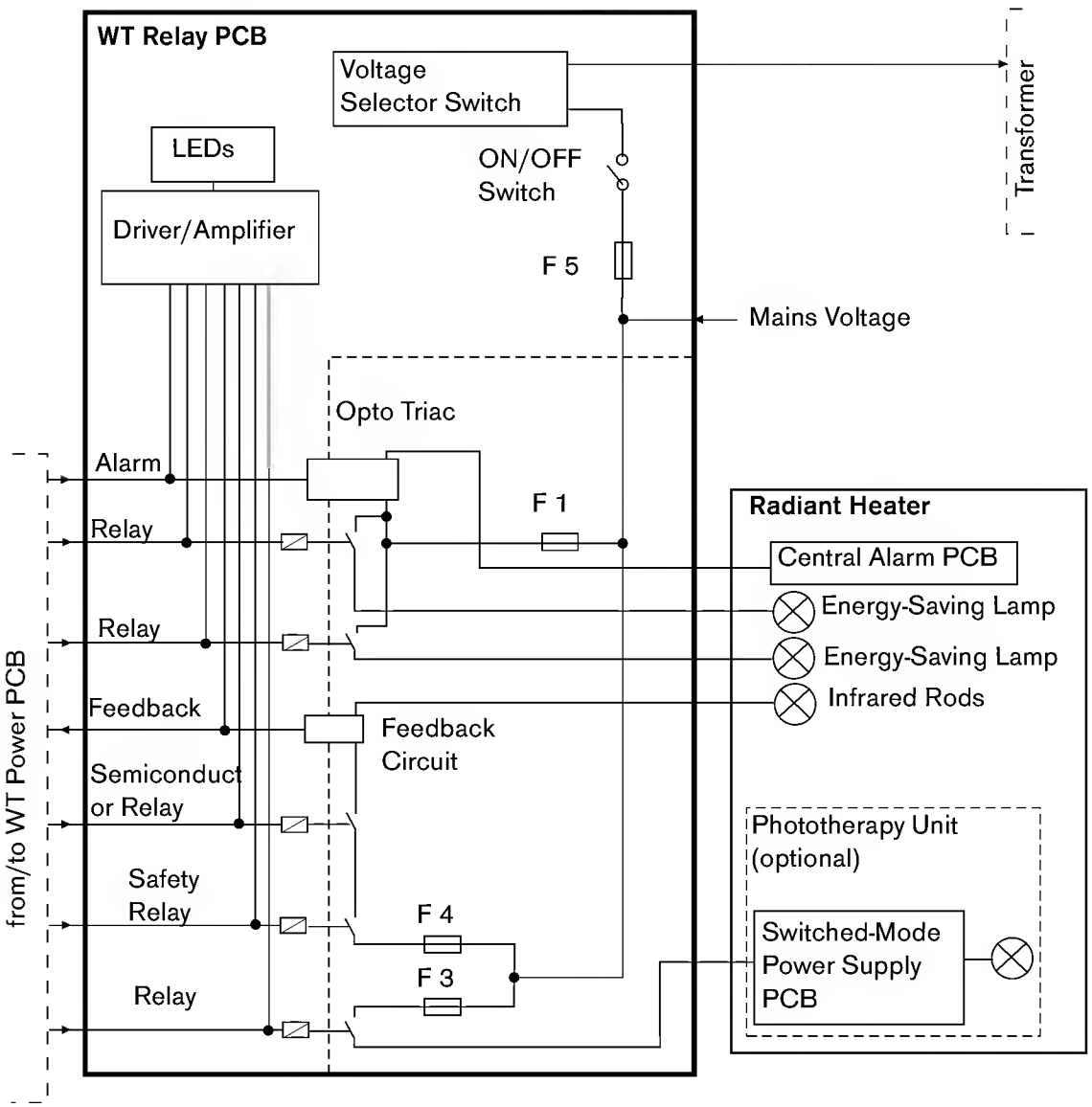

Fig. 21: Block Diagram of WT Relay PCB

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Voltage Selector Switch

The voltage selector switch allows for adapting the primary circuit of the toroidal-core power transformer to the local mains voltage.

Radiant Heater Drive/Feedback

An optocoupler drives the triac, which supplies the infrared rods with mains voltage. The voltage of the infrared rods generates an acknowledgement signal with an optocoupler.

Infrared Rod Safety Relay

The safety relay interrupts mains voltage to the infrared rods in the event of an error (e.g. “Inop”).

Relays (Energy-Saving Lamps, Phototherapy Unit (optional))

The relays supply the energy-saving lamps and the phototherapy unit (optional) with mains voltage.

Drive for Central Alarm PCB

An opto triac at the WT Relay PCB drives the central alarm lamp. The opto triac supplies the Central Alarm PCB with mains voltage.

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2.2.5 WT Controller PCB

The WT Controller PCB contains the following subassemblies:

- Microcontroller
- Quartz element
- EPROM
- EEPROM
- RAM
- Watchdogs
- Driver elements
- Multiplexer and A-D converter
- Linkage and drive for the mattress heater safety relay.

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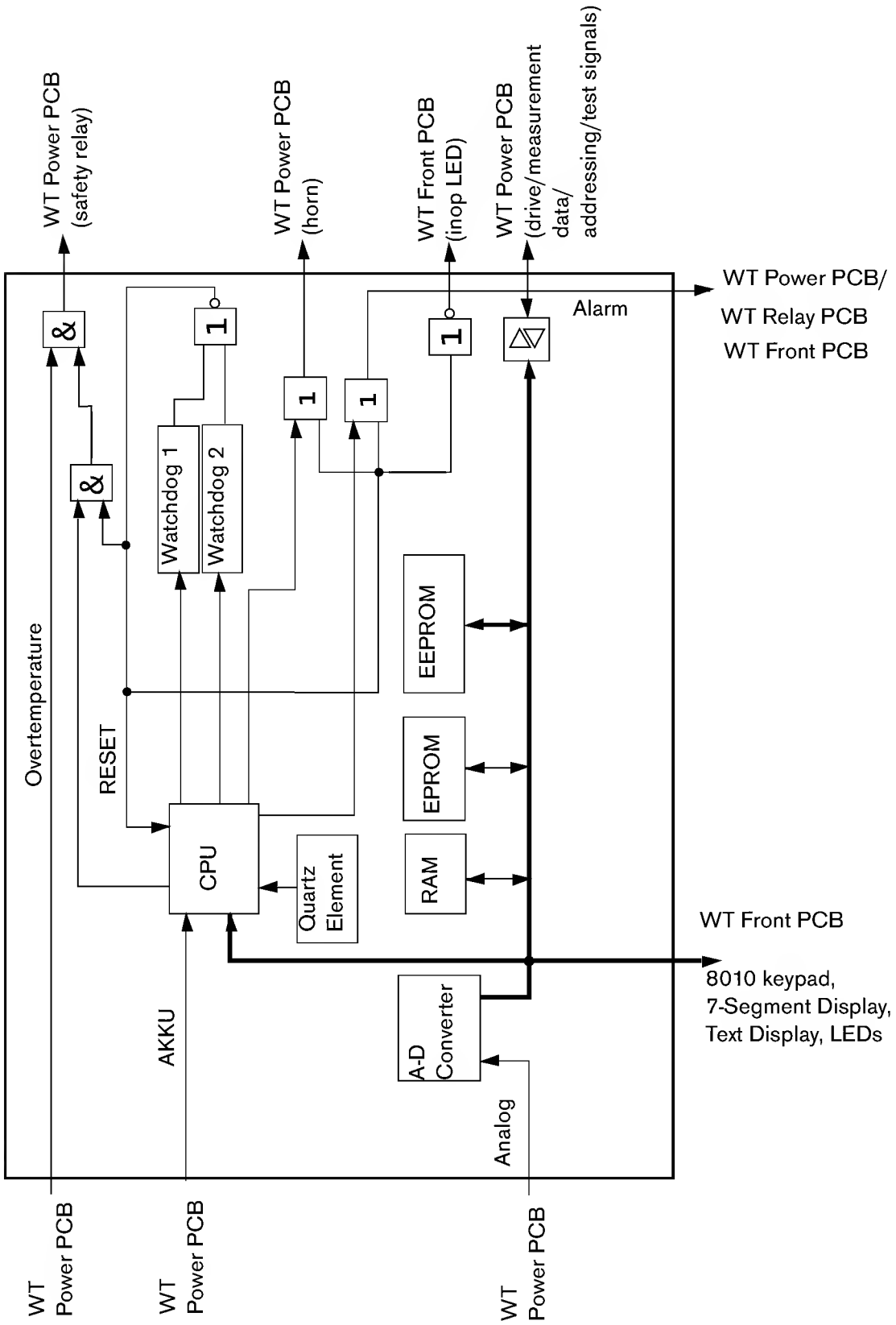

Fig. 22: Block Diagram of WT Controller PCB

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Microcontroller

The microcontroller controls and monitors the Babytherm program. The microcontroller contains 2 KB RAM. Target values are stored and buffered in this RAM. An accumulator RAM buffer voltage is generated by the GoldCap.

Quartz Element

The quartz element generates a pulse frequency of approximately 32 MHz. The microcontroller generates a frequency of 16 MHz with this pulse frequency.

EPROM

The EPROM contains the Babytherm software program.

EEPROM

The EEPROM stores device configuration data.

RAM

The RAM is the main memory.

Watchdogs

The watchdogs monitor the software program sequence of the microcontroller. The watchdogs are counting elements, which are timed with a separate quartz element.

If the microcontroller does not reset the counting elements, an EMERGENCY STOP signal is generated.

Driver Elements

The driver elements amplify the signals and adjust their levels for the actuator driver.

Multiplexer and A-D Converter

The A-D Converter converts the +5 VLED voltage and the GoldCap voltage into a digital data word. This data word is sent to the microcontroller for the purpose of evaluation.

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Linkage and Drive for the Mattress Heater Safety Relay

The overtemperature signal from the WT Power PCB and the output signal from the watchdogs are linked with the drive signal for the mattress heater safety relay.

If overtemperature occurs at the mattress heater, or if the watchdogs are not reset regularly, the mattress heater safety relay at the WT Power PCB power is switched off.

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2.2.6 WT Sensor PCB

The WT Sensor PCB includes the following subassemblies:

- Receiver and sender for serial data transmission
- Test signal select logic
- Measurements amplifiers (skin temperature, mattress heater)
- Overtemperature comparator
- Test circuit (41.6 °C - mattress heater)
- Test circuit (36.0 °C - skin temperature)
- A-D conversion with multiplexer.

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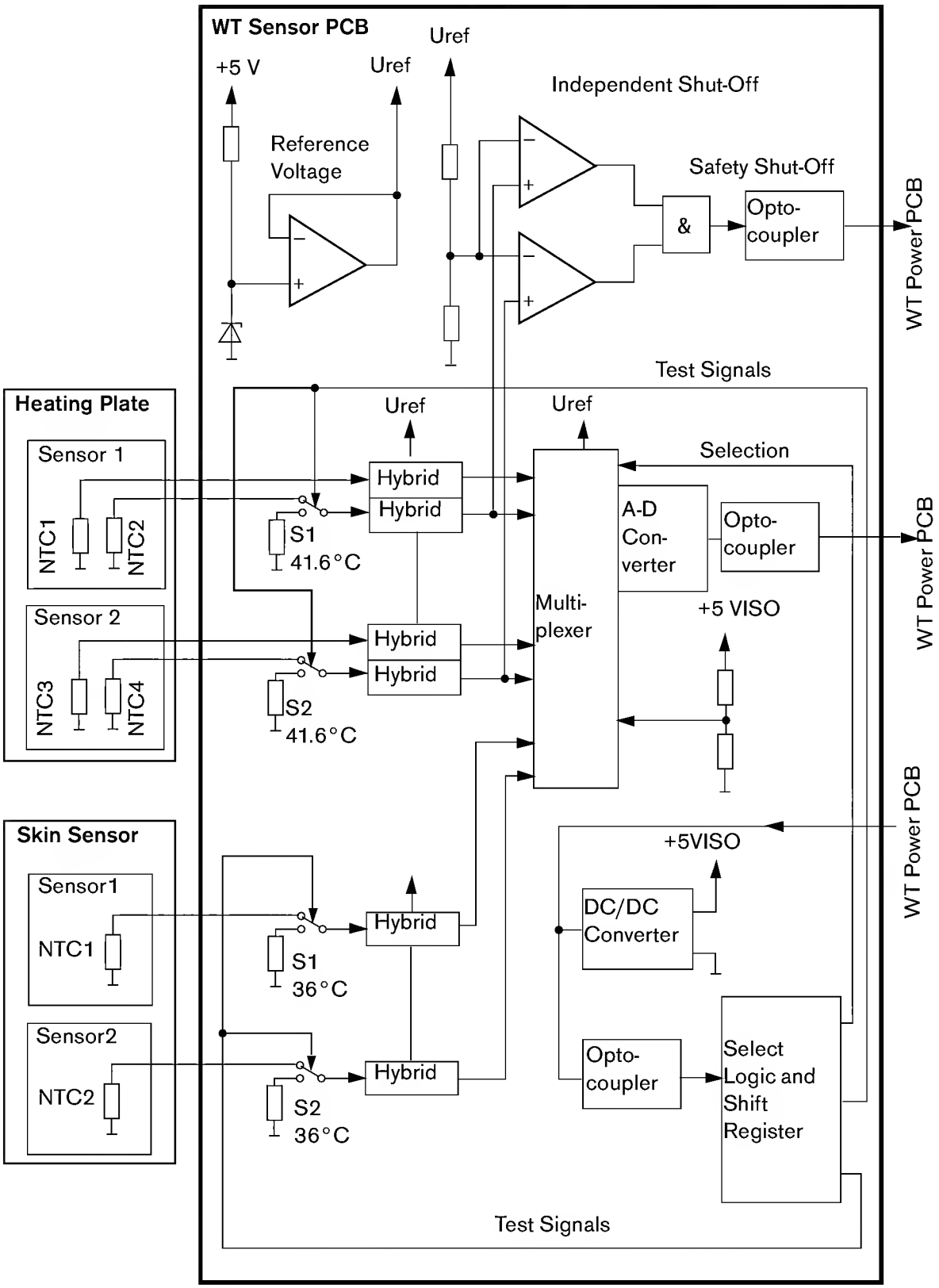

Fig. 23: Block diagram of WT Sensor PCB

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Receiver and Sender for Serial Data Transmission

Optocouplers transmit the serial measurement data (mattress heater, skin temperature) and the WT Sensor PCB operating voltage to the WT Power PCB. One optocoupler receives the test signals in serial mode for the measurement circuits. One optocoupler transmits the overtemperature signal to the WT Power PCB.

Test Signal Select Logic

An addressing module and a shift register convert the serial test signals into parallel data.

The test signals activate the following test circuits:

- Overtemperature, mattress heater (41.6 °C)
- Skin temperature (36 °C)

Measurement Amplifiers (Skin Temperature, Mattress Heater)

Two skin temperature hybrids measure the skin temperature.

Four measurement amplifiers (NTCs) measure the mattress temperature in pairs. The NTCs are installed to the mattress in pairs. The measurement values at a single pair may not deviate from one another more than 0.5 °C. The two measurement pairs may not deviate from one another more than 5 °C. One measurement amplifier per pair evaluates the overtemperature of the mattress heater (greater than 41.6 °C).

Overtemperature Comparator

Two comparators evaluate the mattress heater overtemperature signals. The comparators are set to a voltage value, which corresponds to a mattress temperature of greater than 41.6 °C.

If the mattress reaches a temperature of 41.6 °C or greater, The output level of the corresponding comparator approaches zero V. The mattress heater safety relay is switched off by the hardware.

Test Circuit (41.6 °C - Mattress Heater)

A test circuit regularly monitors for correct functioning of the mattress heater overtemperature comparator.

Test Circuit (36.0 °C - Skin Temperature)

The software monitors the skin temperature hybrid.

Reference resistors, which are linked to the test circuits, are connected to the inputs of the

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skin temperature hybrids. The output voltage values of the skin temperature hybrids correspond to a temperature of 36.0 °C.

A-D Conversion with Multiplexer

The multiplexer sends an analog measurement signal (skin temperature and mattress temperature) to the integrated A-D converter. The serial output signal from the A-D converter is connected to an optocoupler.

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2.3 Panel

The panel consists of the following subassemblies:

- 8010 WT LED PCB
- 8010 keypad
- Text display
- WT Front PCB
- Loudspeaker.

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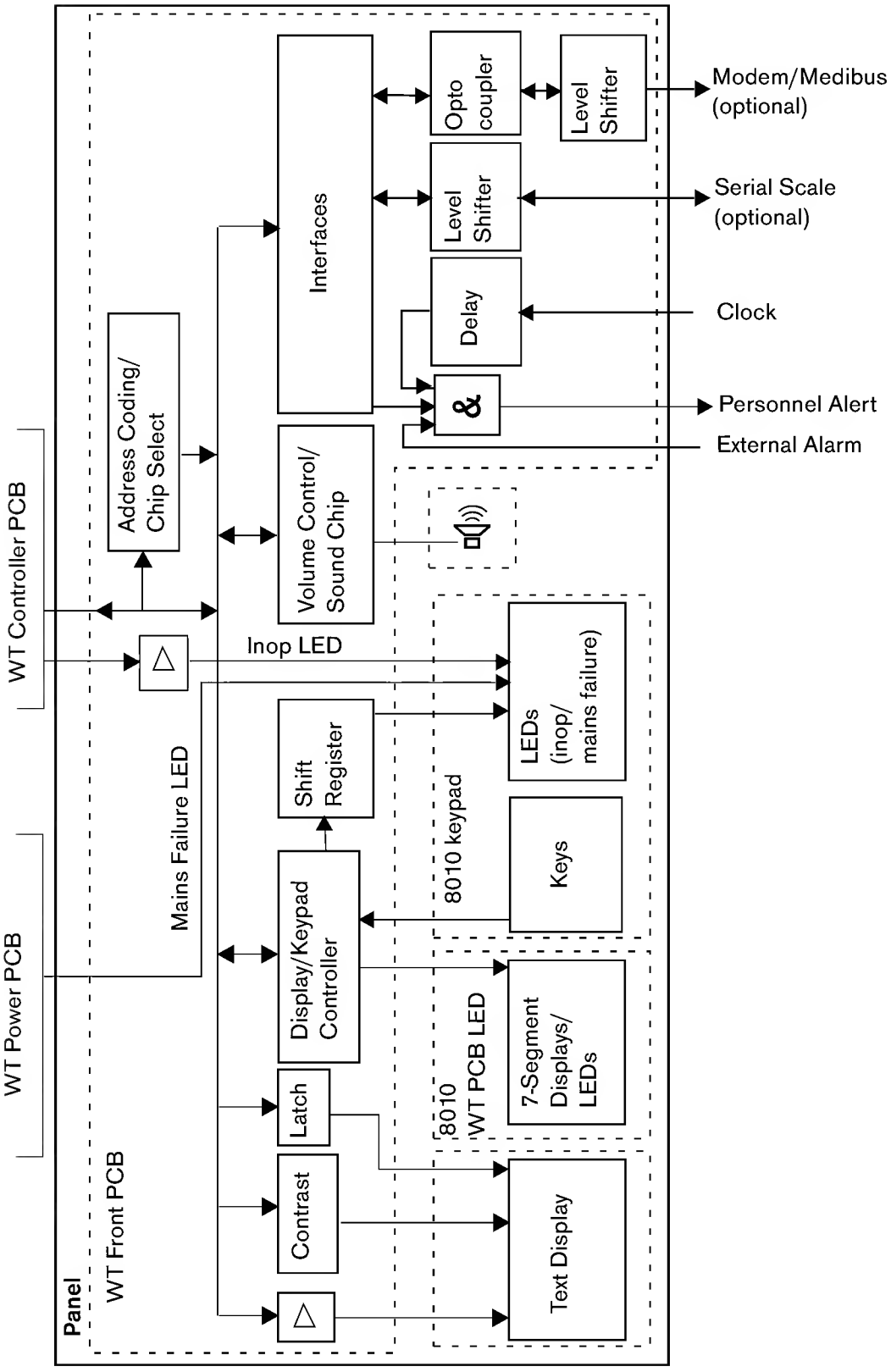

Fig. 24: Block diagram of the Panel

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2.3.1 8010 WT LED PCB

The 8010 WT LED PCB contains 7-segment displays and light emitting diodes.

The 7-segment displays represent the skin temperature and the mattress temperature. The LEDs represent the foot symbol and the mattress heater values < 36 °C and > 38 °C.

2.3.2 8010 Keypad

The 8010 keypad includes a key array, keys and LEDs.

2.3.3 Text Display (LC display)

The text display shows clear text messages (comments, warnings, alarms and commands).

2.3.4 Loudspeaker

Acoustic alarms are generated at the loudspeaker for alarms and comments. A volume control and a sound chip control the loudspeaker.

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2.3.5 WT Front PCB

A port component reads in the key array. LED drive is accomplished with decoders, shift registers and multiplex signals.

The WT Front PCB contains the following subassemblies:

- Address coding and chip select
- Sound chip with volume regulator
- Text display contrast adjustment
- Text display latch drive
- Voltage supply for text display backlighting
- Personnel alert
- Interface modules
- Level shifters
- Optocouplers
- Display module
- LED matrix drive.

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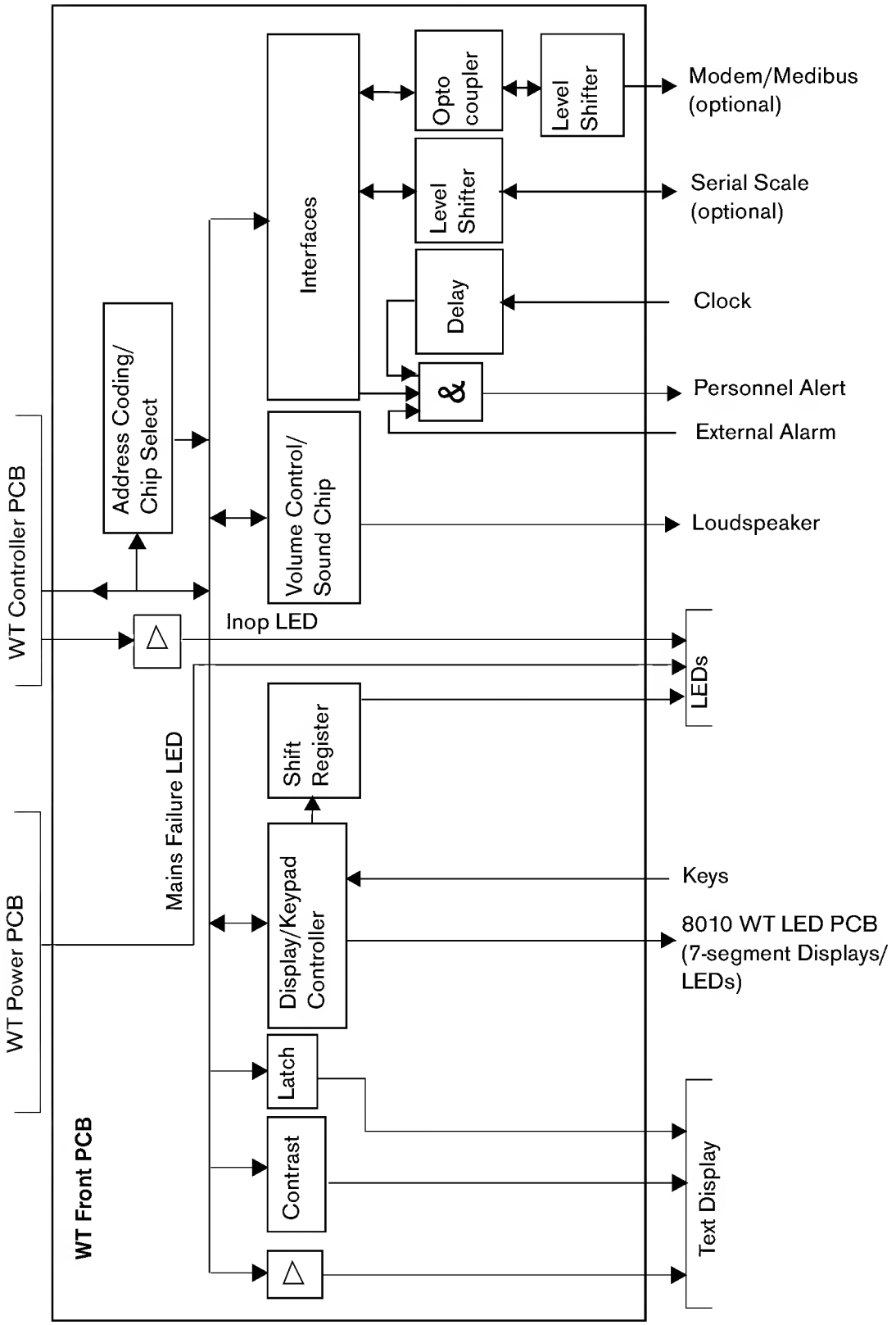

Fig. 25: Block Diagram of the WT Front PCB

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Address Coding and Chip Select

Addressing and selection modules select the various hardware components.

Sound Chip with Volume Regulator

The microcontroller links the output signal of the sound chip to the output signal of the volume regulator. The combined signal is amplified and fed to the loudspeaker.

The microcontroller can influence the volume of the volume regulator via software.

Text Display Contrast Adjustment

An amplifier module enables contrast adjustment at the text display.

Text Display Latch Drive

Latch modules drive the text display signal.

Voltage Supply for Text Display Illumination

A switching controller supplies the text display backlighting foil with a voltage of approximately 1.0 V to 5.0 V.

Personnel Alert

In the event of an alarm a relay is activated. The relay functions as a selector switch. An external alarm system can be connected to the selector switch (e.g. personnel alert).

An alarm delay prevents the personnel alert from being immediately activated after the Check key has been actuated.

Interface Modules

The interface modules link the data bus to the peripheral units (medibus, modem, scale).

Level Shifters

The level shifters adapt the WT Front PCB interface to the peripheral devices interfaces.

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Optocouplers

Optocouplers isolate the modem, the medibus and the central alarm from the WT Front PCB.

Display Module

The display module provides the 7-segment display with operating voltage. The display module selects the individual keys. The display module stores the actuated key in an storage area, and sends this as information to the data bus.

LED Matrix Drive

A shift register and select logic drive the LED matrix.

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3 Trolley

The trolley consists of a small or large trolley plate. The trolley plate is keyed to the metal casing of the column.

The Babytherm is available with various trolleys:

- Babytherm without electric height adjustment
- Babytherm with electric height adjustment (optional).

3.1 Electric Height Adjustment (Optional)

The trolley with electric height adjustment has an adjustable work height of 885 mm to 1180 mm (small lifting column) or 950 mm to 1245 mm (large lifting column).

3.2 Options (for Retrofitting)

- Swivel cabinet
- Infusion bottle holder
- Bed canopy
- Swivel tray.

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4 Resting Surface

The resting surface includes a mattress heater.

The resting surface consists of the following subassemblies:

- Resting surface
- Bottom section tilt mechanism, bolted to base plate
- Mechanical system of tilt mechanism
- 4 corners for holding glass panels.

Various side panels can be attached to the resting surface:

- Side panels, height 23 cm
- Side panels, height 15 cm
- inner walls, 7 cm.

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The resting surface is finely adjustable with click-stop positions. The head of the patient can be brought to the maximal upper position (20 °), or the maximal lower position (15 °).

- Pull the unlocking handle in direction **A**.
- If you push the handle down (**B**), you change the upper head position.
  If you pull the handle up (**C**), you change the lower head position.

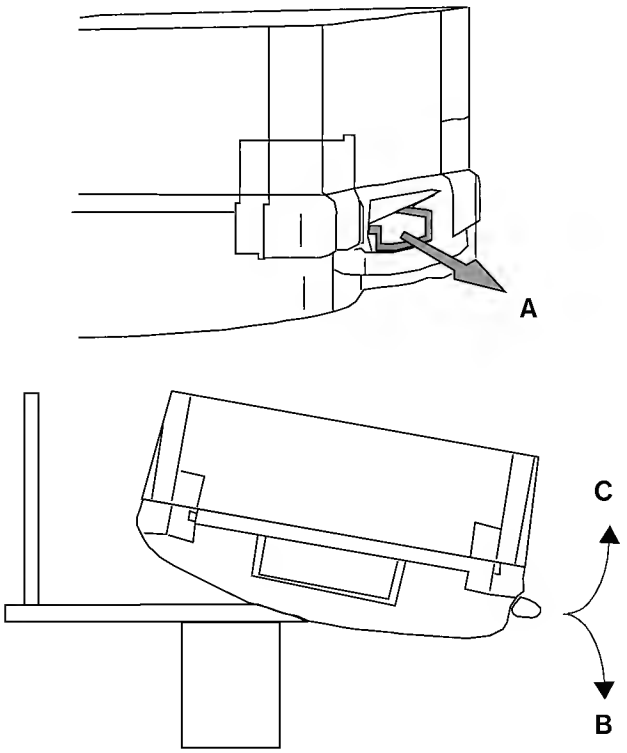

Fig. 26: Inclination adjustment for the resting surface

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4.1 X-ray drawer (Babytherm 8004)

Babytherm 8004 has a X-ray drawer.

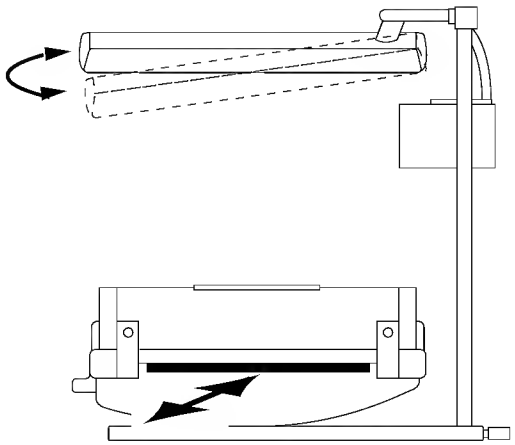

Fig. 27: Babytherm 8004 with X-ray drawer

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5 Mattress

The Babytherm 8010 may be used with different mattress.

5.1 Gel Mattress

The gel mattress consists of a highly heat-conductive gel that does not run or dislocate even when the bed is tilted. The gel is surrounded by a film of soft material compatible with the skin.

The mattress moulds itself to the body contours of the patient lying on it, thereby providing a large contact surface that transfers warmth to the patient and avoids pressure points (anti decubitus effect). The gel has good heat storage properties. If the mains supply is interrupted, e.g. for in-hospital transport, the patient will be kept warm about 15 minutes, provided the insulation is sufficient (blanket, cover).

When the gel mattress is cold, warmth is transferred from the patient to the mattress.

Risk of burns! Do not use gel mattress in other warming beds with heater plate temperatures above 40 °C. **Use the gel mattress in devices which have a lower heater plate temperatures than 40 °C.**

Risk of cooling the patient! The unheated gel mattress would cool the patient. **Use the gel mattress in conjunction with the resting surface heater.**

Risk of damage to the gel mattress! Sharp objects can damage the gel mattress. **Keep clear of sharp objects.**

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5.1.1 Unheated Foam Rubber Mattress

Use the unheated foam rubber mattress if the Babytherm 8010 does not work with the resting surface heater.

6 Pneumatics (Suction)

Two suction devices can be used in the Babytherm 8010:

- Suction device –0.9 bar
- Suction device –0.9 bar.

The infinite vacuum is generated by an ejector. The suction device is supplied by way of the O_2 or compressed-air system. All plastic parts subject to contamination can be sterilised in an autoclave at temperatures up to 134 °C.

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